Human Activities of Costal Area and Land-Based Water Pollutant into the Sea of Japan

Human Activities of Coastal Area and Land-based Water Pollutant into the Sea of Japan

Katsuhiro SAKURAI[a]

(a) Ocean Policy Research Foundation, Kaiyo-Senpaku Bldg., 1-15-16, Toranomon, Minato-Ku, Tokyo, 105-0001,JAPAN

We focus on the Sea of Japan, which is a sea area located along the northeastern part of the Asian continent. It is separated from the North Pacific Ocean by the Japanese Archipelago and Sakhalin. The Sea of Japan area consists of Japan, DPR Korea, South Korea, China, and Far East Russia in Northeast Asia, and the countries have to cooperate in order to control ocean environment and attain sustainable development in the regions. Figure 1 shows the location of the Sea of Japan and the surrounding countries and regions. The green area is our study area. Classification of target area and its data are shown in Table 1.

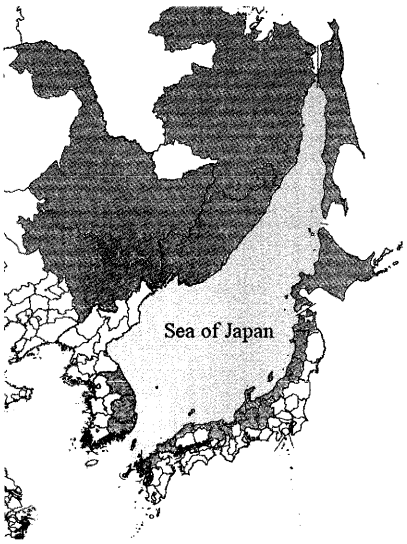

Figure 1 Sea of Japan and target area

This study estimates total amount of land-based water pollutant from human activities in coastal area of the Sea of Japan. Then, an investment policy to reduce the land-based water pollutant from coastal area into the Sea of Japan is evaluated by a system simulation approach. The system simulation model is formulated by an objective function, which is defined as maximizing of total GDP, the structure of environmental system, and the socio-economic system of target countries and regions in coastal area of the Sea of Japan. The purpose of this study is to present an optimal international investment for water environment taking account of economic situations and environmental influences of this area over a certain period of time through the dynamic simulation.

Table 1 Classification of target area

Country	Index	Prefecture	Area (10^4km^2)	Population(1,000) (1995)	GRP(billion dollar) (1995)
Japan	1	Hokkaido	7.8	5,719	208.9
	2	Aomori, Akita, Yamagata	3.1	4,000	129.5
	3	Niigata, Nagano, Toyama	3	5,820	229.1
	4	Ishikawa, Fukui, Gifu	1.9	4,108	155.8
	5	Kyoto, Hyogo	1.3	7,960	318.6
	6	Yamaguchi, Shimane, Tottori	1.6	2,957	105.6
	7	Fukuoka, Saga, Nagasaki	1.1	7,345	260.1
South Korea	8	Kangwon-do, Gyeongsangbuk-d	3.6	4,308	4.4
	9	Busan, Gyeongsangnam-do	1.1	7,843	8.7
China	10	Ji Lin	18.7	25,920	13.5
	11	Heilongjiang	45.5	37,010	24.1
Russia	12	Khabarovsk Krai	82.4	1,608	4.3
	13	Primorsky Krai	16.6	2,287	3.5
	14	Sakhalinskaya Oblast	8.7	699	1.7

Table 2 Pollutant indices

Index	Pollutant
1	COD (Chemical Oxygen Demand)
2	CO_2

Table 3 Classification of industry

Index	Industries
1	Agriculture
2	Manufacturing Industry
3	Construction Industry
4	Communication and Transportation
5	Commerce and Services
6	Others

As shown in Table 2, pollutant indices measured in this study are COD (Chemical Oxygen Demand) and CO_2 from human activity in coastal area. Human activity is divided into industrial and household activities. The water pollutant is originated by industrial and household wastewater, and air pollutant is also emitted from such two kinds of activities.

Industrial activity is classified into 6 categories in

[a] Electronic Address: k-sakurai@sof.or.jp

Table 3. It is assumed that "Others" emits no water pollutants in this model. In Table 4, it is shown that household wastewater disposal system, which is connected to each household, and data of each facility user in our target area.

In Table 5, we estimate total amount of land-based water pollutant from coastal area. Total amount of COD inflow is derived from multiplying total amount of COD emission of human activity by environmental purification ratio. Table 6 shows total GDP and GRP (regional GDP) in each target area.

We establish simulation cases shown as Table 7, and the running period is set from 1995 to 2007 in the calculation. For example, Case00 is assumed as the basic case maximizing GDP of the target area in the last term with restriction of 0% reduction rate of COD inflow and air pollutant emission based on 1995 data.

In this study, we can obtain the feasible solution, which achieves 6% maximum reduction rate of COD inflow in the last term and 5% reduction rate of CO_2 emission of the first period through the simulation term. It is concluded that Case06 is the feasible and preferable solution from viewpoint of average amount of COD and CO_2 emission, and economic development of target area (See Figure 2). It is also important for abatement of water pollutant to invest for environmental policy and to promote technologies by industrial and economic development. Furthermore, countries and regions around the Sea of Japan area have to cooperate to manage an international ocean in various fields such as water environment, industrial technology, etc., from integrated ocean management perspective.

Table 4 Classification of household wastewater disposal system (1,000 person, 1995)

Index	Treatment Facility	Japan	South Korea	China	Russia
1	Sewage System	24,819	4,637	12,598	689
2	Rural Community Sewage System	1,115	0	0	0
3	Combined Treatment Septic Tank	3,231	0	0	0
4	Treatment Septic Tank	8,496	0	0	0
5	Night Soil Septic Tank	248	0	0	0
6	Untreated Domestic Wastewater	0	6,403	50,332	3,905
Total		37,909	11,040	62,930	4,594

Table 5 Estimate of total COD emission and inflow of each zone (ton/year)

Index	Household wastewater	Industry wastewater	Total emission	Total inflow
1	5,882	6,209	12,092	8,732
2	13,048	3,849	16,897	11,430
3	18,694	6,812	25,506	17,414
4	13,635	4,632	18,267	12,432
5	12,021	9,472	21,493	15,271
6	8,971	3,140	12,111	8,254
7	12,316	7,732	20,047	14,067
Total in Japan	84,568	41,846	126,413	87,600
8	26,572	2,577	29,149	14,816
9	27,393	4,841	32,234	17,021
Total in South	53,965	7,418	61,383	31,838
10	207,620	453	208,074	33,582
11	296,455	809	297,264	48,080
Total in China	504,075	1,262	505,337	81,662
12	13,660	498	14,158	5,862
13	19,425	602	20,028	8,252
14	6,970	269	7,240	3,004
Total in Russia	40,055	1,370	41,425	17,118
Total in the Sea of Japan area	682,662	51,895	734,560	218,217

Table 6 Total GDP of each zone in the Sea of Japan area (million dollars)

Index	1	2	3	4	5	6	7
GRP	208,860	129,458	229,126	155,803	318,599	105,606	260,052
Index	8	9	10	11	12	13	14
GRP	44,025	86,718	13,523	24,126	8,099	9,790	4,378
Total GDP in the Sea of Japan area	1,598,163						

Table 7 Simulation cases

Case	Case00	Case01	Case02	Case03
Reduction rate of COD	0%	1%	2%	3%
Restriction of CO_2	1995 level	1995 level	1995 level	1995 level
Case	Case04	Case05	Case06	Case07
Reduction rate of COD	4%	5%	6%	7%
Restriction of CO_2	1995 level	1995 level	1995 level	1995 level

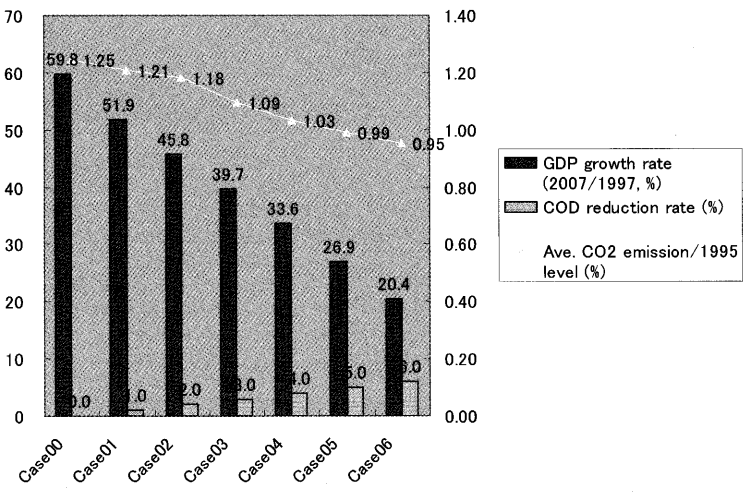

Figure 2 Simulation result